

# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : ASAHI OPTICAL CO LTD

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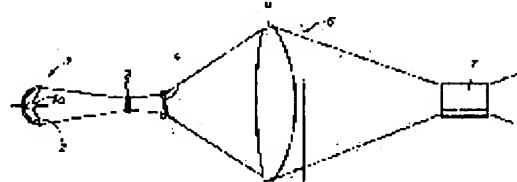
(72)Inventor : ABE TETSUYA

## (54) LIGHTING OPTICAL DEVICE

### (57)Abstract:

PURPOSE: To increase the lighting efficiency, to use a large-power light source, and to improve the illuminance of a lighting body by arranging an anamorphic optical system between a fly-eye lens and a lighting area.

CONSTITUTION: The anamorphic optical system constituted by combining, for example, a cylinder lens 4 and a toric condenser lens 5 with each other is arranged between the fly-eye lens 3 and lighting area 6. The light from the light source 1 is made incident on the fly-eye lens 3, whose projection light is converged by the cylinder lens 4 and toric condenser lens 5, and then transmitted through a lighted body provided in the lighting area 6 and made incident on a projection optical system 7. Even when this optical system is used, the illuminance distribution of the lighting area 6 can be made uniform on condition that the entrance pupils of the fly-eye lens 3 and projection optical system 7 are conjugate. In this case, ≥2 anamorphic optical elements are combined to meet conjugation requirements.



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CLAIMS

## [Claim(s)]

[Claim 1] Illumination-light study equipment which is made to carry out incidence of the image of the light source to a condensing lens through a fly eye lens, and is characterized by having arranged anamorphic optical system between said fly eye lenses and said lighting area in the illumination-light study equipment which arranges the illuminated body of the translucency which should be illuminated between this condensing lens and projection optics.

[Claim 2] Illumination-light study equipment according to claim 1 with which said fly eye lens and location of the entrance pupil of said projection optics are characterized by being conjugation also to which a direction perpendicular to an optical axis.

[Claim 3] Illumination-light study equipment according to claim 2 characterized by the cross-section configuration of said fly eye lens being a rectangle.

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DETAILED DESCRIPTION

## [Detailed Description of the Invention]

## [0001]

[Industrial Application] This invention relates to the illumination-light study equipment especially using a fly eye lens about the illumination-light study equipment which can be widely used for optical instruments, such as photoengraving process, an inspection projector, a stepper, a projector, and a projector.

## [0002]

[Description of the Prior Art] A fly eye lens (eye lens of a fly) is known as an optical element which generally changes and carries out outgoing radiation of the include-angle information on the beam of light which carries out incidence to the information on a location, diffuses the light of the light source and, specifically, is used for homogeneity as an optical diffusion component for giving the illuminated body. For example, in a photoengraving-process system, when illuminating the reflective film which photoed the manuscript and projecting on PS plate by projection optics, this fly eye lens is arranged between the light source and a condensing lens, the image of the light source is diffused in homogeneity and the block-copy film placed between a condensing lens and projection optics by this diffused light is illuminated. Rather than a diffusion plate, this fly eye lens has the high spreading effect of light, and can illuminate the illuminated body to homogeneity more. Generally each microlens which constitutes a fly eye lens is making the shape of the shape of a cross-section cylindrical and the square pole, and a hexagonal prism, and a fly eye lens is constituted by bundling this.

[0003] It is indicated by the Japanese-Patent-Application-No. No. 141340 [ 63 to ] specification that the configuration of the lighting area by the fly eye lens turns into an incidence side edge side configuration of each microlens which constitutes a fly eye lens with an analog. Moreover, since the illuminated body is a rectangle in such an application in many cases, in order to lessen the loss of the illumination light, it is necessary to make the configuration of lighting area into the configuration of the illuminated body, and the rectangle which is similarity.

[0004] On the other hand, the exit pupil of each microlens which constitutes a fly eye lens is produced in the location of a injection side, and the configuration is proportional to the include angle of incoming beams. That is, if the radial flux of light carries out incidence, an exit pupil configuration will become round, and the diameter of an exit pupil becomes large, so that the include angle of incoming beams is large.

[0005] therefore, the case where the incidence side cross-section configuration of each microlens is made into a rectangle as indicated by the Japanese-Patent-Application-No. No. 141340 [ 63 to ] specification -- the magnitude of an exit pupil -- a injection side cross section -- large -- becoming -- a mole cricket -- \*\*\*\* -- in order to lose the end and the illumination light or to make magnitude of an exit pupil small, the include angle of incoming beams must be made small, and it becomes difficult to fully raise the illuminance of a lighting object.

[0006] Then, by using anamorphic optical system, even if it does not make the cross-section configuration of a fly eye lens into a rectangle, it is possible to illuminate rectangular area efficiently. Also in the optical system which used anamorphic optical system according to an artificer's knowledge, if a fly eye lens and the entrance pupil of projection optics are conjugation, the illumination distribution of lighting area becomes uniform and conjugation conditions can be satisfied by moreover combining the anamorphic optical element of two or more sheets.

## [0007]

[Problem(s) to be Solved by the Invention] In view of the trouble of such a conventional technique, and an

artificer's knowledge, the main purposes of this invention are in the illumination-light study equipment using the fly eye lens for illuminating the lighting area which makes a rectangle to offer the illumination-light study equipment which raised lighting effectiveness, and enabled it to raise the illuminance of a lighting object as was moreover able to use the big light source of power.

[0008]

[Means for Solving the Problem] According to this invention, such a purpose is attained by offering the illumination-light study equipment which is made to carry out incidence of the image of the light source to a condensing lens through a fly eye lens, and is characterized by having arranged anamorphic optical system between said fly eye lenses and said lighting area in the illumination-light study equipment which arranges the illuminated body of the translucency which should be illuminated between this condensing lens and projection optics.

[0009]

[Example] Drawing 1 is the optical-path Fig. simplifying and showing the illumination-light study equipment based on this invention. Incidence of the light of the light source 1 is carried out to the fly eye lens 3 with which a cross-section configuration comes to combine much square microlens 3a (drawing 2), and after being condensed with the cylinder lens 4 and the toric condensing lens 5, the outgoing radiation light of this fly eye lens penetrates the illuminated body prepared in the rectangular lighting area 6 (drawing 3), and it carries out incidence to projection optics 7 (drawing 4).

[0010] The light source 1 comes to combine extra-high-pressure-mercury-lamp 1a and the ellipse reflective mirror 2 in this illumination-light study equipment. Since the luminous intensity distribution of a mercury lamp are partial in the direction perpendicular to an electrode, they can incorporate the illumination light efficiently by combining an ellipse mirror.

[0011] Although a mercury lamp is suitable in many applications, according to a request, a halogen lamp can also be used as the light source. Since the halogen lamp has the almost fixed luminous-intensity-distribution pattern in the radiation direction, it can incorporate the illumination light efficiently by arranging a spherical mirror to the opposite side and making a condenser lens turn and reflect the illumination light in it using the big condenser lens of NA.

[0012] In the fly eye lens 3, microlens 3a has a square cross section, respectively, and can incorporate the light from the light source 1 without futility. Moreover, image formation of the incident ray image of the plane of incidence of microlens 3a is carried out to the lighting area 6, and since image formation of the outgoing radiation beam-of-light image from the injection side of microlens 3a is carried out to projection optics 7, illumination-light study equipment with the high use effectiveness of light is obtained. And also in the optical system which used such anamorphic optical system, if the fly eye lens 3 and the entrance pupil of projection optics 7 are conjugation, the illumination distribution of the lighting area 6 becomes uniform, and conjugation conditions can be satisfied by moreover combining two or more the anamorphic optical elements 4, for example, a cylinder lens, and the toric condensing lenses 5. Consequently, even when the usual light source is used, using a fly eye lens, it can have high effectiveness and, moreover, rectangular lighting area can be illuminated suitable for homogeneity.

[0013] In the above-mentioned example, in order to consider as the configuration with which all the illumination-light bundles are incorporated by projection optics 7, an illumination-light bundle cannot be made not much long and slender. That is, lighting area cannot be made into a narrow width more than a certain extent. In that case, in the above-mentioned example, still more long and slender luminous intensity distribution are obtained, and if a cross-section configuration uses the fly eye lens which makes a rectangle, since luminous intensity distribution will also serve as a rectangle, if the fly eye lens which comes to combine a rectangular microlens is used, even if the width of face of lighting area is a narrow width more, high lighting effectiveness will be acquired.

[0014]

[Effect of the Invention] The optical system from a fly eye lens to plane of projection can be managed with 1 set, and, moreover, a uniform light effect is acquired. moreover, the pupil produced according to the light source --- a mole cricket --- \*\*\*\* --- even if it uses a square microlens so that there may be nothings, it becomes possible to have high effectiveness and to illuminate rectangular lighting area.

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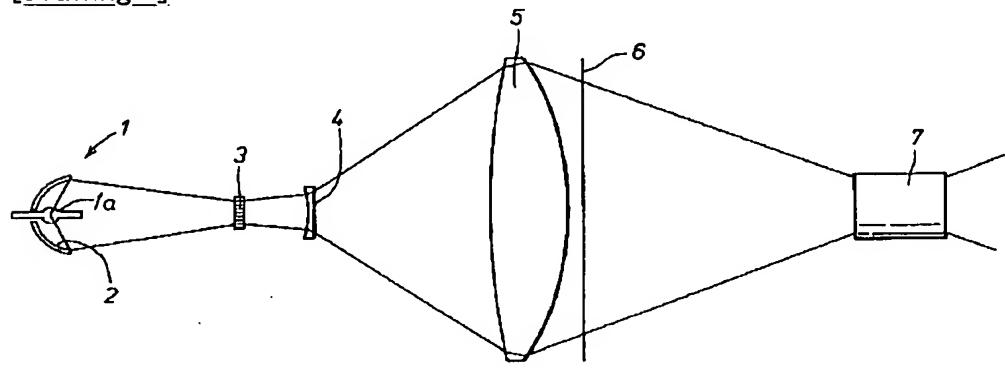
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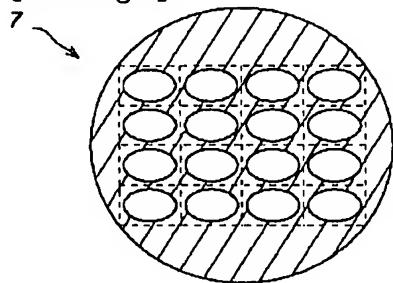
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## DRAWINGS

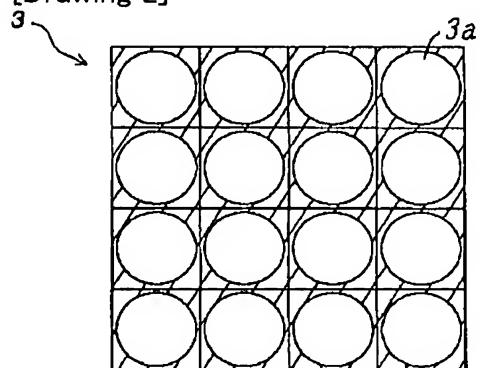
[Drawing 1]



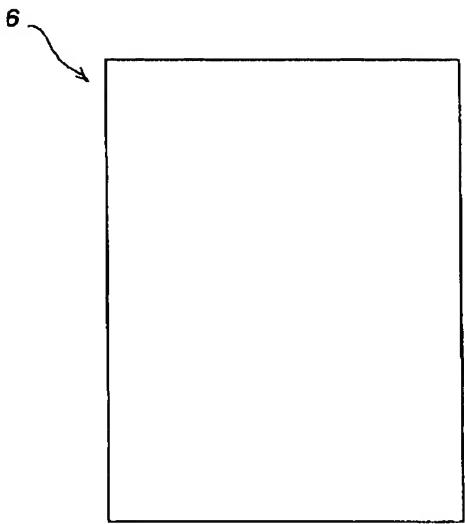
[Drawing 4]



[Drawing 2]



[Drawing 3]



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